The Vegetative Growth and Development of *Dracocephalum Moldavica* Under Different Soil Moisture Levels

Shima Alaei, and Reza Omidbaigi

***Abstract*----**A pot experiment was carried out in a completely randomized design with 4 treatments and 4 replications to study the effect of different irrigation regimes on growth and yield in Dragonhead. The treatments were 100%, 85%, 75% and 55% of field capacity. According to the results of statistical analysis, irrigation treatments had significant effects on growth, yield and water relations. As the amount of irrigation water decreased, the plant height, leaf area, leaf number, leaf chlorophyll, fresh and dry weight of shoot and root, root length, branch number, leaf relative water content (RWC) and yield per pot decreased but root to shoot ratio, day number after sowing for first bloom, first flower and first fruit increased.

***Keywords*---**Dragonhead *(Dracocephalum moldavica*), water stress, growth, yield, leaf relative water content (RWC).

I. Introduction

DRAGONHEAD with scientific name of *Dracocephalum.moldavica* from Lamiaceae family is one of the medicinal and aromatic plants that its essential oil uses widely in medicinal, food, cosmetic and health industrials. Dragonhead cultivated in different regions of Iran (Omidbaigi, 2000).

High percent of medicines are used in developed countries have herbal origin. Drought stress is major factors limiting plant productivity in semi arid and arid regions around the world. It causes a decline in primary metabolites which results a shortage of precursors necessitated for the synthesis of secondary compounds (Soliman, 1992). With regard to development of drought lands and the shortage of agricultural land it comes into great importance to make use of drought tolerant plant. Determination of medicinal plants growth under different water stresses could be a well guidance for cultivation of resistant plant in dry regions (Lebaschy, 2004). Since dragonhead is an important plant in medicine, the investigations in to the cultivation aspects of this plant are essential.

Shima Alaei, Department of Agronomy and Plant Breeding, College of Agriculture, Kermanshah Branch, Islamic Azad University, Kermanshah, Iran

Reza Omidbaigi Department of Horticultural Sciences, College of Agriculture, University of Tarbiat Modaress, Tehran, Iran

II Material and methods

A pot experiment in randomized complete block design with 4 treatments of water stress separately and 4 replications was conduct to study the effect of different irrigation regimes on growth and yield in *Dracocephalum. Moldavica*.

The seeds were used in this investigation were provided from Medicinal and Aromatic Plants, Department of Corvinus University in Budapest. Similar size pots were filled with 3750gr sand and soil. A sample of soil was sent to laboratory for determining of chemical and physical characteristics.

The seeds sowed into the sandy loam soil. During germination until stage of 6-8 leaf, irrigation treatments were completed. Drought treatments used after rehabilitation of plants.

Irrigation treatments selected based on different percentage of field capacity (FC) that was determined by pressure plate set. Amount of field capacity was 21%.

Irrigation treatment select on different percentage of field capacity including:

1-Control – full irrigation-100%F.c (3896 gr)

2-Moderate water stress -85% F.c. (3814 gr)

3- Moderate water stress -75% F.c. (3759 gr)

4- Sever water stress -55% F.c. (3650 gr)

The pots irrigated according to their weight every day. In order to evaluate growth and yield indices of Dragonhead plant under different water stresses, chlorophyll content (by spad , time of the first bloom, time of primary opening of flower and fruit, stem height, number of leaf, dry and fresh weight of leaf, stem, shoot and root, root length, plant wet weight, yield ,root/shoot ration dry matter, leaf area and RWC (leaf relative water content) by turner method (1981) determined.

RWC(%)=(FW- DW)/ (TW-DW) 100

FW=fresh weight

DW= dry weight

TW= turgesunce weight

At the end of experiment, data were analyzed using MSTATC computer software and mean were compared by statistical test. We considered differences significant at p values 0.05%.

III Result

The results indicated that by increasing water stress level, date of first bloom, first flower and first fruit increased that was statistically significant ($p<0.05$) at 55% F.C level. In 85%

F.C bloom, flower and fruit appeared sooner than the other treatments (table 1).

The results indicated that by increasing water stress level, leaf number, stem length, fresh and dry weight of leaf decreased that was statistically significant ($p<0.05$) at 75% F.C level (table1,2). Also decreasing of Branch number, dry weight of root and Stem down diameter was observed that there was statistically significant at 55% F.C level at 5% level using DMRT. Also water stress affected on leaf relative water content (RWC) severely. This factor showed significant reduction at 55% F.C levels (table 1, 2 and 3). The decreasing of fresh and dry weight of stem, shoot, fresh weight of plant, leaf area and Yield per pot was statistically significant ($p<0.05$) at 75% and 55% F.C level. The highest and least of leaf area and yield per pot concerned to 100% and 55% F.C treatments (table 2 and 3).

Table 3 shows the effect of water stress on root, shoot and root/shoot dry weight ratio as by increasing of water stress, fresh and dry weight of root and length of root decreased that was statistically significant at 55% F.C level at 5% level using DMRT. It is well known that with increased water stress level, root/shoot dry weight ratio increased, that was statistically significant ($p<0.05$) (table1). The highest and least of fresh and dry weight of root and length of root was concerned to 85% and 55% F.C treatment respectively (table1).

Root growth was more than stem growth at all of the water stress treatments. Decreasing of growth in 55% F.C level was statistically significant at $P\leq0.05$. The results showed that increasing of water stress, decreased leaf chlorophyll significantly ($p<0.05$) in 55% F.C level. The highest and least of leaf chlorophyll amount concerned to lack (control) and 55% F.C of water stress treatment (table1).

TABLE I

EFFECT OF WATER STRESS TREATMENTS ON VEGETATIVE GROWTH INDICES IN *DRACOCEPHALUM. MOLDAVICA*.

Vegetative growth indices							
Irrigation	Chlorophyll (spad)	First bloom (day after sowing)	First flower (day after sowing)	First fruit (day after sowing)	Leaf number	Branch number	Height stem (cm)
I1	48.15 A	76 B	88 B	101B	328.8 A	10 A	31.85 A
I2	47.28 A	75 B	85 B	97 B	274 A	10.20 A	32.90 A
I3	44.63 AB	77 B	88 B	100 B	190.7 B	9.727 A	26.55 B
I4	37.45 B	99 A	108 A	130 A	62.68 C	2.75 B	12.23 C

†Means in each column with the same letter are not significantly different at 1% level; DNM

TABLE II

EFFECT OF WATER STRESS TREATMENTS ON VEGETATIVE GROWTH INDICES IN DRACOCEPHALUM. MOLDAVICA.

Vegetative growth indices							
Irrigation	Leaf wet weight(gr)	Leaf dry weight (gr)	Shoot wet weight(gr)	Shoot dry weight (gr)	Stem wet weight(gr)	Stem dry weight (gr)	Stem down diameter (mm)
I1	5.325 A	1.175 A	9.450 A	2.375 A	2.55 A	1.00 A	3.775 A
I2	4.8 A	1.025 A	7.825 B	1.775 B	2.275 AB	0.65 B	3.825 A
I3	3.375 B	0.725 B	5.325 C	1.150 C	1.450 B	0.35 C	3.450 A
I4	o.825 C	0.225 C	1.225 D	0.45 D	0.375 C	0.10 D	2.600 B

†Means in each column with the same letter are not significantly different at 5% level; DNMR

TABLE III

EFFECT OF WATER STRESS TREATMENTS ON VEGETATIVE GROWTH INDICES IN DRACOCEPHALUM. MOLDAVICA.

Vegetative growth indices								
Irrigation	Root wet weight(gr)	Root dry weight(gr)	Root length(cm)	Plant wet weight (gr)	Yield per pot (gr)	R/S dry weight ratio	Leaf area(mm	RWC(%)
I1	1.45A B	0.275 A	14.73 AB	12.6 A	50.50 A	0.12 B	39350 A	80.18 A
I2	1.55 A	0.3 A	17.35 A	10.8 A	43.45 A	0.17A	33160AB	79.72 A
I3	1.025 B	0.2 AB	16.67 A	7.0 B	28.01 B	0.17A	23500 B	77.42 A
I4	0.275 C	0.0750 B	13.80 B	1.95 C	7.75 C	0.17 B	6563 C	63.08 B

†Means in each column with the same letter are not significantly different at 5% level; DNMRT.

IV. DISCUSSION

The result of effect of different soil moisture levels on growth, yield and accumulation of compatible solutes in basil showed that as the amount of irrigation water decreased, the plant height, stem diameter, leaf area, fresh and dry weight of shoots and roots, leaf relative water content (RWC) and leaf water potential decreased but root to shoot ratio, prolin and total soluble sugars concentration increased. The results of this study showed that basil plant uses osmoregulation by increasing prolin and soluble sugars level in order to tolerate the water deficit conditions (Hassani, 2004). According to the results of statistical analysis Hassani et al (2004), irrigation treatments (100%,70% and 55% F.c) had significant effects on growth, yield, water relations and amounts of proline and soluble sugars in basil.

This research results about plant height, stem diameter, leaf area and yield are in agreement with the other studies like Hassani(2004), Simon et al.,(1992) in basil, Johnson (1995) in Spanish thyme, Charles et al (1990), Misra and Srivastara (2000) and Alkire et al (1993) in peppermint. However they were significantly different at 5% level of probability, that this result supports other studies.

These results were consistent with Simon et al., (1992) in basil, Johnson (1995) in Spanish thyme who affirmed that water deficit could affect in yield by decreasing of growth.

This results are in agreement with the other studies like Hassani(2006) and BaherNik(2004) that have expressed leaf relative water content decreased. According to BaherNik(2004) research, water stress treatments *Satureja.hortensis*, decreased plant water potential and leaf relative water content (RWC). Also water stress induced high amount of proline. Considerable research indicates that effect of drought stress on length, cross and leaf surface, high plant, stem diameter, lateral shoot, length of highest internodes, weigh of 1000 grain and flower shoot, leaf, stem and biological yield were significant (Hassani,2004 , Saharkhiz,2007 and Safikhani, 2007).

Petropoulos et al (2007) showed that plant growth (foliage and root weight, leaf number) was significantly reduced by water stress, even at 30–45% deficit.

Also Safikhani (2007) showed that effect of different populations of *Dracocephalum. Moldavica* were not significant but effect of drought stress on essence yield, amount of solution carbohydrates, amount of a, b and total chlorophyll at two years were significant. Comparison mean treatments of plant populations and different levels of drought stress showed that at first year highest of essential oil percent related to Esfahan seed and 60% humidity of field capacity.

Effects of water supply and sowing date on the performance and essential oil production of anise (Pimpinella anisum L.) indicated that relative growth rate (RGR), relative water content (RWC), grain yield and essential oil decreased, while the root/shoot ratio and the oil percentage of the seeds increased(Staple, 1984).

V CONCLUSION

According to the results of statistical analysis, irrigation treatments had significant effects on growth, yield and water relations. Because of leaf number decreased so it is correct that leaf area decreased too. On the other hand under sever stress, element absorption decrease so leaf area decrease. This is first mechanism of plant in deficit stress. Whatever leaf area less, transpiration less and plant support stress. The results showed that increasing of water stress, decreased leaf area that lead to less light absorption, leaf chlorophyll content, photosynthesis and growth.

Plants respond quickly to prevent the Photosynthesis. Stomata closure in response to water deficit stress primarily result in decline in the rate of photosynthesis. Photosynthesis limitation causes growth and yield decreasing.

It is well known that with increased water stress level, because shoot growths more than root decreased so root/shoot dry weight ratio increased. Root growth was more than stem growth at all of the water stress treatments.

Water deficit in plants may lead to physiological disorders, such as a reduction in photosynthesis and transpiration, and in the case of aromatic crops may cause significant changes in the yield and composition of essential oils. In 85% F.C bloom, flower and fruit appeared sooner than the other treatments but in sever stress (55% F.C) because, plant grows up a little so bloom, flower and fruit appeared very late. Flowering obtains after specified measure. It could be included from this investigation that low stress (85% F.C) could be applied in dragonhead, because leaf number, leaf, root and stem wet weight, leaf area and yield not showed significant difference.

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